

MITES OF THE GENUS *HYPOASPIS*  
CANESTRINI, 1884 *S.STR.* AND RELATED FORMS  
(ACARI: MESOSTIGMATA)  
ASSOCIATED WITH BEETLES



BY

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MITES OF THE GENUS *HYPOASPIS*  
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INTRODUCTION

RECENTLY Dr C. Athias-Henriot (Laboratoire de Faune du Sol de l'I.N.R.A., Dijon) forwarded to me mite material collected from the scarabaeid beetles *Oryctes rhinoceros* L. and *Oryctes monoceros* Ol. The beetles and mites were laboratory reared and collected by Dr M. J. Stelzer and Mr B. Zelazny (both from U.N./S.P.C. Rhinoceros Beetle Project, Apia, Western Samoa). Mr Zelazny informed me that the mites feed on the beetles' eggs and may therefore have a possible role in the biological control of *Oryctes rhinoceros*, a main pest of Coco-nut palms. According to Mr Zelazny, the mites originally associated with *O. monoceros*, imported from the Ivory Coast, were even more avid egg feeders on the eggs of *O. rhinoceros* than the locally collected mites. One batch of mites, ex *O. rhinoceros*, was tentatively determined as *Coleolaelaps rhinocerotis* (Ouds.), although I was puzzled by the report on their feeding behaviour. It was generally assumed that mites of the genus *Coleolaelaps* Berlese, 1914 are harmless exudate feeders (Grandi, 1925; Vitzthum, 1940-43). A closer examination of material collected by myself from phytophagous scarabaeids in Israel, material collected by Dr M. Remillet (O.R.S.T.O.M., Centre d'Adiopodoume, Abidjan, Ivory Coast) and material from melolonthine beetles in the U.S.A., showed that '*Coleolaelaps*' served actually as a 'dumping ground' for a number of different genera of mites associated with beetles. The mites of the genus *Coleolaelaps* Berlese, 1914 have been dealt with in a separate study (Costa & Hunter, in press) which has shown that *Coleolaelaps* is not closely related to *Hypoaspis* Can. The present paper will deal with the genus *Hypoaspis* s. str. and some additional forms.

The confusion between *Coleolaelaps* s. str. and *Hypoaspis* s. str. seems to have arisen from the fact that both have long 'wavy' setae on the idiosoma as well as macrosetae on the legs, and both are associated with phytophagous lamellicorn beetles. I should like to point out that the 'wavyness' mentioned by many authors is an artefact of the preparation, the materials used causing apparently a slight contraction of the setal core. In living or alcohol-stored specimens the setae are straight or slightly curved.

Mites of the Hypoaspidae are generally considered to be the most primitive group in the Laelapidae (Vitzthum, 1940-43; Evans, 1958) but the taxonomic treatment of *Hypoaspis* Can. s. lat. remains controversial. This has been shortly discussed by Hunter & Costa (in press), who retain at full generic status many of

the subgenera of *Hypoaspis* which have been recorded, though not used, by Evans & Till (1966). The present study supports this view and proposes to show that mites of the genus *Hypoaspis* s. str. are well defined morphologically as well as ecologically in their host associations. A close examination of the symbiotic mites showed a high degree of host specificity and probably in the past several species have been confused with either *Hypoaspis krameri* Can. (the type species of the genus) or *Hypoaspis integer* Berlese sensu Samšičák, 1960, both of which have been also confused with each other.

Evans & Till (op. cit.) have recently described and figured both sexes of *Hypoaspis krameri* from specimens associated with *Lucanus* sp. in Great Britain. Their description agrees with the details which can be learned from the descriptions of *H. krameri* by G. & R. Canestrini (1881), G. Canestrini (1885) and Berlese (1892), making the two undoubtedly congeneric. The host association of the British material makes it debatable if this is actually conspecific with the original *H. krameri* which is associated with *Oryctes nasicornis* L. (compare discussion).

In view of the present study a redefining of *Hypoaspis* s. str. seemed to be necessary.

#### DEPOSITION OF TYPES

The holotypes are deposited in the British Museum (Nat. Hist.). Paratypes will be deposited in The American Museum of Natural History; The Acarina collection, Department of Entomology, University of Georgia and the author's collection.

#### *Hypoaspis* Canestrini s. str.

*Hypoaspis* Canestrini, 1884, *Atti R. Ist. veneto Sci.* (6) 2 : 1569; 1885, *Acarofauna Ital.* part I : 55.

TYPE: *Gamasus krameri* Canestrini, 1881.

FEMALE: Dorsal shield entire, oval, with basically 37 pairs of setae (20 podonotal and 17 opisthonotal, fig. 1). Setae  $i_2$ ,  $s_4$ –6 considerably longer than remaining setae, setae  $Z_4$  extremely long, usually longest idiosomal setae. A tendency exists towards diminishing the number of setae, e.g. in *Hypoaspis integer* Berlese setae  $z_3$  are absent in most specimens; in *Hypoaspis phyllognathi* sp. n. seta  $s_3$  may be absent on one or both sides and *Hypoaspis remilleti* sp. n. lacks setae  $s_3$  in all specimens. Gnathosoma with six rows of deutosternal denticles, setae Hyp. 3 very long, distinctly longer than remaining gnathosomal setae (fig. 7). Sternal shield hexagonal with distinct anterior border. Genital shield tongue-shaped with marginally inserted genital setae. Paranal setae always longer than postanal seta. Peritreme extends anteriorly beyond the margin of coxa I, not attached to dorsal shield. Tarsus II with two subterminal stout, blunt, spur-like setae ( $al_1$  and  $pl_1$ , fig. 4), leg IV with macrosetae on femur ( $ad_1$ ), genu ( $ad_1$ , in some species this seta might be similar in length to the remaining setae of the segment) and tarsus ( $ad_2$ ,  $pd_2$  and  $pd_3$ , fig. 6). Macrosetae are also present on femur II ( $pd_1$ ) and femur III ( $ad_1$ ). Leg chaetotaxy as recorded for free-living laelapids (Evans, 1963).



MALE: With long slender spermadactyl, curved distally (fig. 14). Holoventral shield with 10 pairs of setae in addition to anal setae (various degrees of erosion may separate the anal shield completely in *Hypoaspis integer*). Peritreme anteriorly fused with dorsal shield. Leg II with ventral stout, pointed, spine-like setae on femur to tarsus (fig. 38). Remaining characters as in female.

The mites are usually associated with phytophagous scarabaeids, mainly Dynastinae.

### *Hypoaspis neokrameri* sp. n.

FEMALE: Dorsum covered by single dorsal shield (735  $\mu\text{m}$  long and 445  $\mu\text{m}$  wide) with 37 pairs of setae. Podonotal setae  $i_2$ ,  $s_1$ ,  $s_4-6$  are elongate and distinctly longer than the remaining podonotal setae (fig. 1). The longest dorsal setae are  $Z_4$  (220  $\mu\text{m}$ ), setae  $J_5$  straight and short (30  $\mu\text{m}$ ). The shield is nearly devoid of ornamentation. Tectum (fig. 3) triangular with denticulate proximal margins.

Tritosternum normal with pilose laciniae. Sternal shield (170  $\mu\text{m}$  long and 150  $\mu\text{m}$  wide at  $St_2$ ) well ornamented, posterior margin slightly convex and irregular (fig. 2). Sternal setae long, reaching to or beyond the bases of consecutive setae. Genital shield (distance between genital setae 105  $\mu\text{m}$ ) ornamented and tongue-shaped, metapodal shields narrow. Paranal setae distinctly longer than postanal seta. Peritreme extending anteriorly slightly beyond the middle of coxa I, free anteriorly and posteriorly.

Gnathosoma (fig. 7) with well-sclerotized corniculi and fimbriate internal malae. Six rows of deutosternal denticles (8-14 per row). Movable digit of chelicera (fig. 5) bidentate, fixed digit with one stout tooth and about ten small denticles.

The approximate lengths of the legs (excluding pretarsi) are: I—660  $\mu\text{m}$ ; II—540  $\mu\text{m}$ ; III—600  $\mu\text{m}$ ; IV—850  $\mu\text{m}$ . Tarsus II (fig. 4) with two blunt distal spines, leg IV with macrosetae on the femur (220  $\mu\text{m}$ ), genu and tarsus (fig. 6). Macrosetae present also on femur II (150  $\mu\text{m}$ ) and III (110  $\mu\text{m}$ ). Leg chaetotaxy normal.

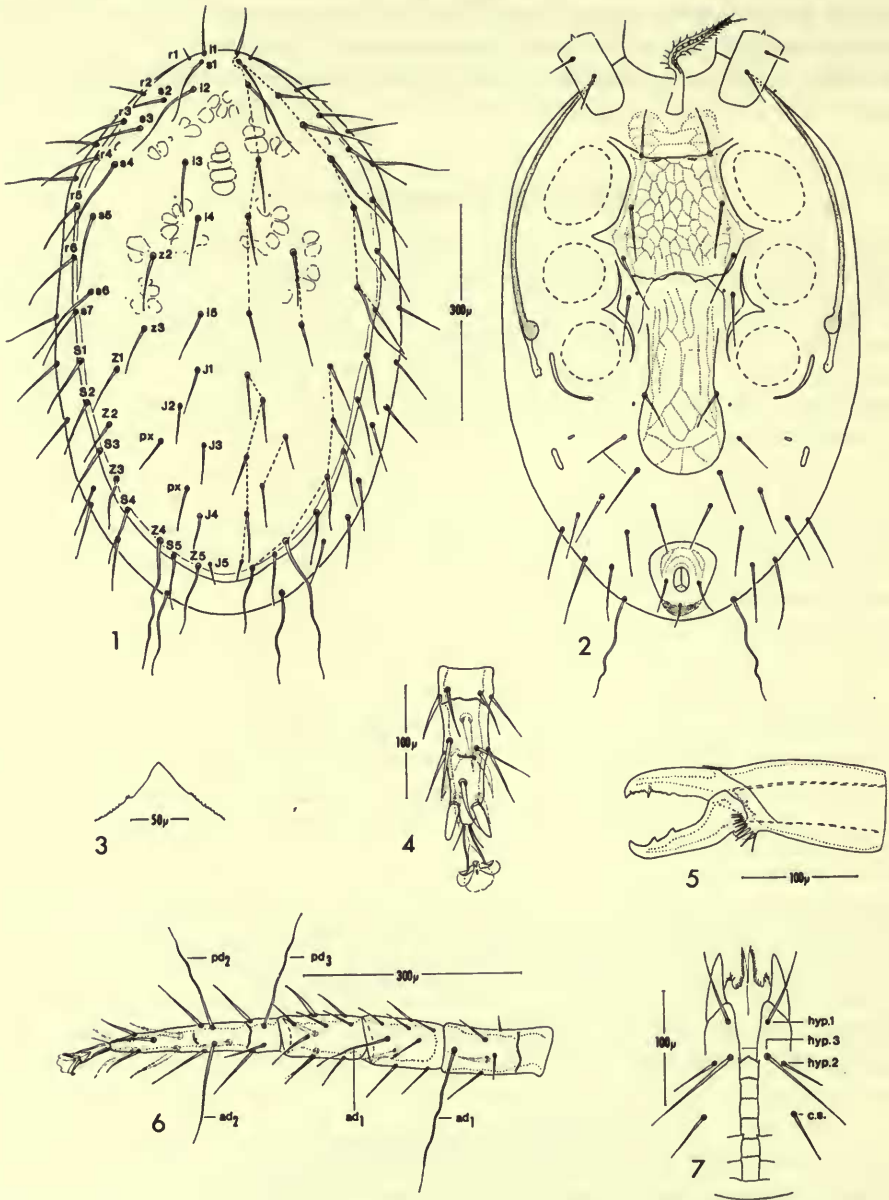
MALE: Unknown.

DIFFERENTIAL DIAGNOSIS: *H. neokrameri* sp. n. can be separated from other species of the complex by its long sternal shield which is longer than wide. Associated with *Oryctes nasicornis* L. (Scarabaeidae: Dynastinae).

MATERIAL: Holotype: ♀, ex *Oryctes nasicornis* L., Tivon, Israel, May 25, 1965, coll. M. Costa. Paratypes: 5♀♀, *ibid.*

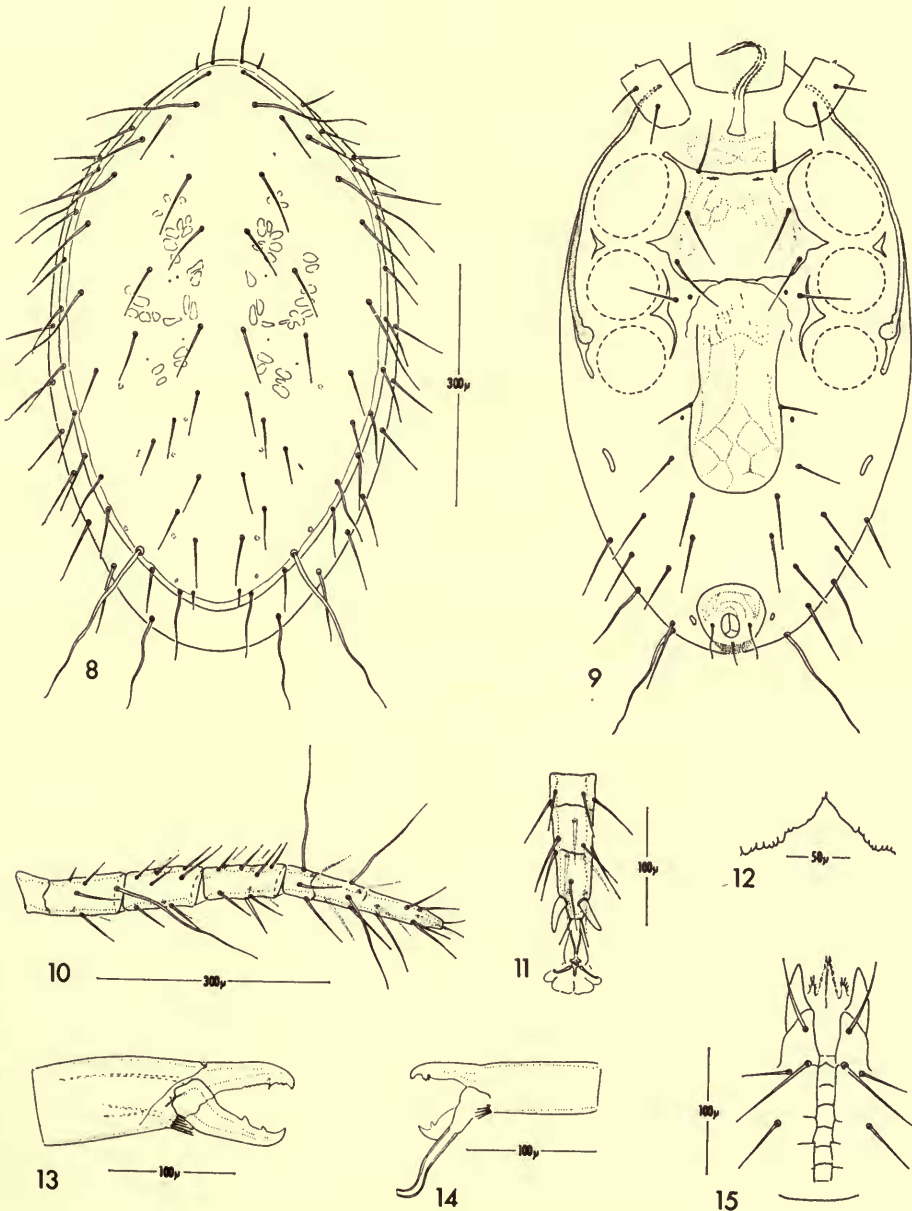
### *Hypoaspis pentodoni* sp. n.

FEMALE: Dorsum covered by a single dorsal shield (680  $\mu\text{m}$  long and 390  $\mu\text{m}$  wide) with 37 pairs of setae. Podonotal setae  $i_2$ ,  $s_4-6$  are elongate and distinctly longer than the remaining podonotal setae (fig. 8). The longest dorsal setae are  $Z_4$  (220  $\mu\text{m}$ ). The shield is nearly devoid of ornamentation, sites of muscle attachments are striated. Tectum (fig. 12) triangular with denticulate margins.



FIGS 1-7. *Hypoaspis neokramevi* sp. n., female. Fig. 1. Dorsum. Fig. 2. Venter. Fig. 3. Tectum. Fig. 4. Tarsus II. Fig. 5. Chelicera. Fig. 6. Leg IV. Fig. 7. Gnathosoma, ventral view.

Tritosternum normal with pilose laciniae. Sternal shield wider than long (125  $\mu\text{m}$  long and 150  $\mu\text{m}$  wide at St2), its posterior margin is nearly straight with two small but characteristic projections (fig. 9). Sternal setae long, extending beyond the



FIGS 8-15. *Hypoaspis pentodoni* sp. n., female. Fig. 8. Dorsum. Fig. 9. Venter. Fig. 10. Leg IV. Fig. 11. Tarsus II. Fig. 12. Tectum. Fig. 13. Chelicera. Fig. 15. Gnathosoma, ventral view. Male. Fig. 14. Chelicera.

bases of consecutive setae. The ornamented genital shield is tongue shaped (distance between genital setae 110  $\mu\text{m}$ ). Metapodal shields narrow. Postanal seta distinctly shorter than paranal setae. The peritreme extends anteriorly beyond the middle of coxa I.

Gnathosoma (fig. 15) with well-sclerotized corniculi and fimbriate internal malae, six rows of tiny deutosternal denticles. Movable digit of chelicera (fig. 13) bidentate, fixed digit with small denticles.

The approximate lengths of the legs (excluding pretarsi) are: I—650  $\mu\text{m}$ ; II—540  $\mu\text{m}$ ; III—530  $\mu\text{m}$ ; IV—750  $\mu\text{m}$ . Tarsus II (fig. 11) with two blunt distal spines. Leg IV (fig. 10) with macrosetae on femur (210  $\mu\text{m}$ ), genu and tarsus ( $pd_3$ —165  $\mu\text{m}$ ).

MALE: The single male specimen is smaller than the female (dorsal shield 580  $\mu\text{m}$  long and 330  $\mu\text{m}$  wide). Venter covered by well-ornamented holovenal shield with 10 pairs of setae in addition to the anal setae. Chelicera (fig. 14) with slender, distally curved, spermadactyl. Remaining characteristics as in female, except peritreme which is attached anteriorly to the dorsal shield.

DIFFERENTIAL DIAGNOSIS: This species can be separated from *H. neokrameri* sp. n. by its short sternal shield and from *H. phyllognathi* sp. n. by its shorter dorsal setae. Associated with *Pentodon bispinosus* Küst (Scarabaeidae: Dynastinae).

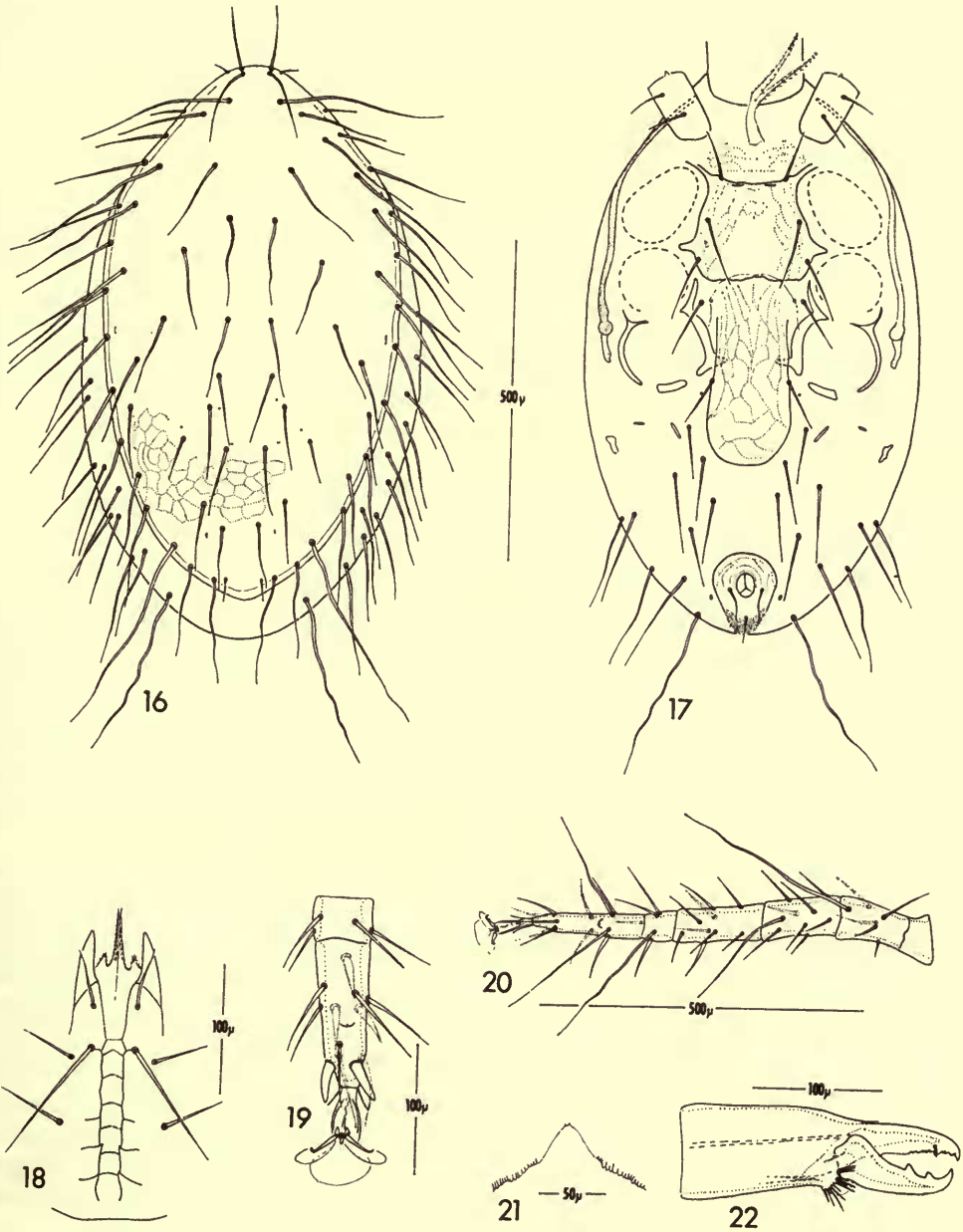
MATERIAL: Holotype: ♀ ex *Pentodon bispinosus* Küst, Mishmar Haemek, Israel, Sept. 21, 1962 coll. M. Costa. Paratypes: all from the same host and locality: 1♂, 1♀, May 19, 1965; 5♀♀, Sept. 21, 1962; 6♀♀, Sept. 12, 1966; 1♀, Nov. 8, 1965.

### *Hypoaspis phyllognathi* sp. n.

FEMALE: Dorsum covered by single dorsal shield (840  $\mu\text{m}$  long and 470  $\mu\text{m}$  wide) which is ornamented with small polygons mainly in the posterior area. Regularly 37 pairs of simple setae are inserted on the shield, but in several specimens setae  $s_3$  are absent on one or both sides. Podonotal setae  $i_2$  and  $s_4$ –6 are distinctly longer than the remaining podonotal setae. The longest dorsal setae are  $Z_4$  (320  $\mu\text{m}$ ), setae  $J_5$  straight and short (30  $\mu\text{m}$ ). The distribution and relative lengths of the setae are shown in fig. 16. Tectum (fig. 21) triangular, proximal margins deeply denticulate.

Tritosternum normal with pilose laciniae. Sternal shield (145  $\mu\text{m}$  long and 155  $\mu\text{m}$  wide at  $St_2$ ) well sclerotized, only faintly ornamented. Sternal setae very long,  $St_2$  extends beyond the posterior margin of the shield (fig. 17). The tongue-shaped genital shield (distance between genital setae 125  $\mu\text{m}$ ) has nearly parallel sides and is well ornamented. The anal shield is rounded anteriorly, the postanal seta is distinctly shorter than the paranal setae. The anal shield is flanked posteriorly by a pair of long setae. Metapodal shields small, irregular in shape. The peritreme extends anteriorly to the anterior margin of coxa I, it is free both anteriorly and posteriorly.

Gnathosoma (fig. 18) with well-sclerotized corniculi and fimbriate internal malae, with six rows of minute deutosternal denticles. Movable digit of chelicera (fig. 22)



FIGS 16-22. *Hypoaspis phyllognathi* sp. n., female. Fig. 16. Dorsum. Fig. 17. Venter. Fig. 18. Gnathosoma, ventral view. Fig. 19. Tarsus II. Fig. 20. Leg IV. Fig. 21. Tectum. Fig. 22. Chelicera.



bidentate, fixed digit with 8 small denticles in addition to a large tooth which is associated with the pilus dentilis.

The approximate lengths of the legs (excluding pretarsi) are: I—730  $\mu\text{m}$ ; II—570  $\mu\text{m}$ ; III—600  $\mu\text{m}$ ; IV—870  $\mu\text{m}$ . Tarsus II (fig. 19) with two dorsal distal blunt spines, leg IV (fig. 20) with macrosetae on the femur (300  $\mu\text{m}$ ), genu (210  $\mu\text{m}$ ) and tarsus. Macrosetae are also present on femora II and III, leg chaetotaxy normal.

MALE: Unknown.

DIFFERENTIAL DIAGNOSIS: This species can be recognized by its long dorsal setae, its large size and by the long seta  $ad_1$  (210  $\mu\text{m}$ ) on genu IV. Associated with *Phyllognathus silenus* F. (Scarabaeidae: Dynastinae).

MATERIAL: Holotype: ♀, ex *Phyllognathus silenus* F., Bardawil, Northern Sinai, April 10, 1968, beetle coll. H. Sandler. Paratypes: 13 ♀♀, same data; 6 ♀♀, Carmia, Israel, Nov. 16, 1966; 1 ♀, Tivon, Israel, May 6, 1966; 2 ♀♀, Ein Yahav, Israel, May 1, 1968.

### *Hypoaspis integer* Berlese, 1911 sensu Samšičák, 1960

*Laelaps (Hypoaspis) integer* Berlese, 1911, *Redia* 7 : 186.

?*Coleolaelaps integer* Willmann, 1935, *Bull. Mus. R. Hist. nat. Belg.* 11 : 23–25, figs 14–6.

*Coleolaelaps integer* (male) Samšičák, 1960, *Cas. čsl. Spol. ent.* 57 (3) : 280–82, figs 1–6.

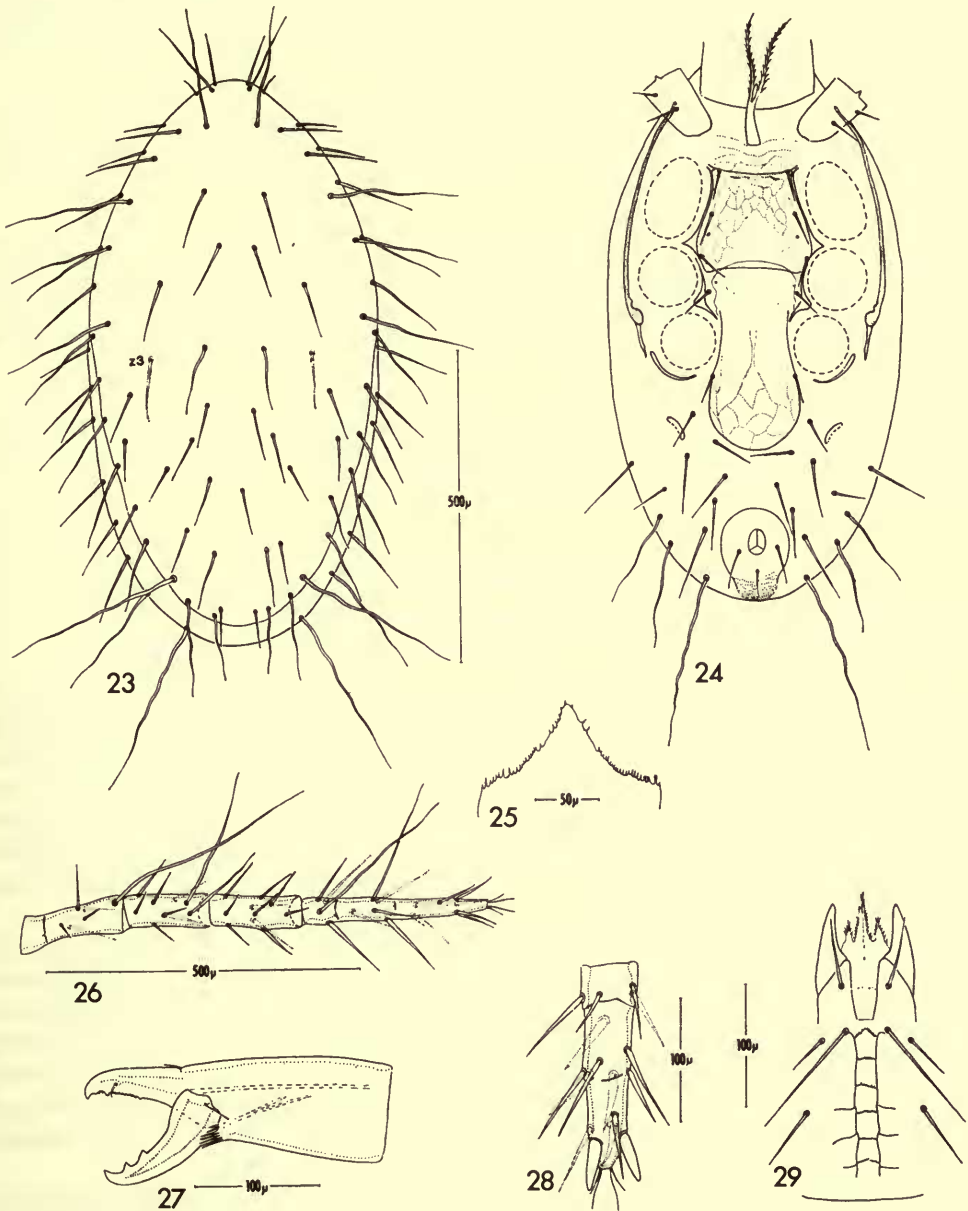
FEMALE: Dorsum covered by single dorsal shield (820  $\mu\text{m}$  long and 430  $\mu\text{m}$  wide) with 36–37 pairs of setae. Of 29 investigated specimens, setae z3 were completely absent in 19 specimens, unilaterally present in 8 and bilaterally present in 2 specimens only. Podonotal setae i2, s1, s4–6 are elongate, the longest dorsal setae are Z4 (280  $\mu\text{m}$ ) and a pair of postero-marginal setae (200  $\mu\text{m}$ ) which are inserted on the soft integument. The shield is devoid of distinct ornamentation, the distribution and relative lengths of the setae are shown in fig. 23. Tectum (fig. 25) triangular with denticulate margin.

Tritosternum normal with pilose laciniae. Sternal shield (150  $\mu\text{m}$  long and 150  $\mu\text{m}$  wide at St2) ornamented with short sternal setae which do not reach the bases of the consecutive setae (fig. 24). Metasternal setae inserted on integument. The large genital shield (distance between genital setae 130  $\mu\text{m}$ ) expands slightly beyond the genital setae and is ornamented. Metapodal shields narrow, kidney-shaped. Anal shield with semicircular anterior border, postanal seta distinctly shorter than paranal setae. The anal shield is flanked posteriorly by a pair of long (300  $\mu\text{m}$ ) setae. The narrow peritreme extends anteriorly to the middle of coxa I.

Gnathosoma (fig. 29) with well-sclerotized corniculi and fimbriate internal malae, six rows of tiny deutosternal denticles (about 12 per row). Movable digit of chelicera (fig. 27) bidentate, fixed digit with one large tooth and about 10 sub-equal small denticles.

The approximate lengths of the legs (excluding pretarsi) are: I—680  $\mu\text{m}$ ; II—620  $\mu\text{m}$ ; III—580  $\mu\text{m}$ ; IV—960  $\mu\text{m}$ . Tarsus II (fig. 28) with two dorsal distal blunt spines, with ventral setae markedly stouter than the dorsal setae. Leg IV

(fig. 26) with macrosetae on femur ( $360\ \mu\text{m}$ ), on the genu ( $ad_1$ — $250\ \mu\text{m}$ ,  $pd_1$ — $180\ \mu\text{m}$ ) and tarsus; macrosetae are also present on femur II ( $270\ \mu\text{m}$ ) and III ( $260\ \mu\text{m}$ ). Leg chaetotaxy normal for the genus.



FIGS 23-29. *Hypoaspis integer* Berlese, female. Fig. 23. Dorsum. Fig. 24. Venter. Fig. 25. Tectum. Fig. 26. Leg IV. Fig. 27. Chelicera. Fig. 28. Tarsus II. Fig. 29. Gnathosoma, ventral view.

**MALE:** The male has been described by Samšínák (1960). The ventral sclerotization is extremely variable, out of 14 male specimens only one had a complete holoven-tral shield, in one specimen this was eroded but the anal shield was still broadly connected to the ventral shield and in 12 specimens, with variously shaped genito-ventral shields, the anal shield was completely separate. In the males the cor-responding macrosetae are longer than in the females.

**DIFFERENTIAL DIAGNOSIS:** The long macrosetae on femora II and III, as well as the two macrosetae on genu IV are good diagnostic characters for this species. Associated with *Oryctes nasicornis* L. (Scarabaeidae: Dynastinae) and *Polyphylla fullo* L. (Scarab.: Melolonthinae).

**NOTES:** The original association seems to be with *O. nasicornis*, the association with *P. fullo* appears to be secondary (vide Costa & Hunter, in press). The speci-mens ex *P. fullo* (the beetles were kindly loaned by the American Museum of Natural History) were collected from beneath the elytra by methods described by Costa & Hunter (op. cit.).

**MATERIAL:** 2 ♂♂, 28 ♀♀, ex *Oryctes nasicornis*, Bohemia, Liblice, July 16, 1960, coll. and det. K. Samšínák; 5 ♂♂, 53 ♀♀ *Polyphylla fullo*, S. Russia; 3 ♂♂, 41 ♀♀, *ibid.*, Prussia; 4 ♂♂, 56 ♀♀, *ibid.*, Germany, 1897.

### *Hypoaspis rhinocerotis* Oudemans, 1925

*Hypoaspis rhinocerotis* Oudemans, 1925, *Ent. Ber., Amst.* 7 (146) : 30.

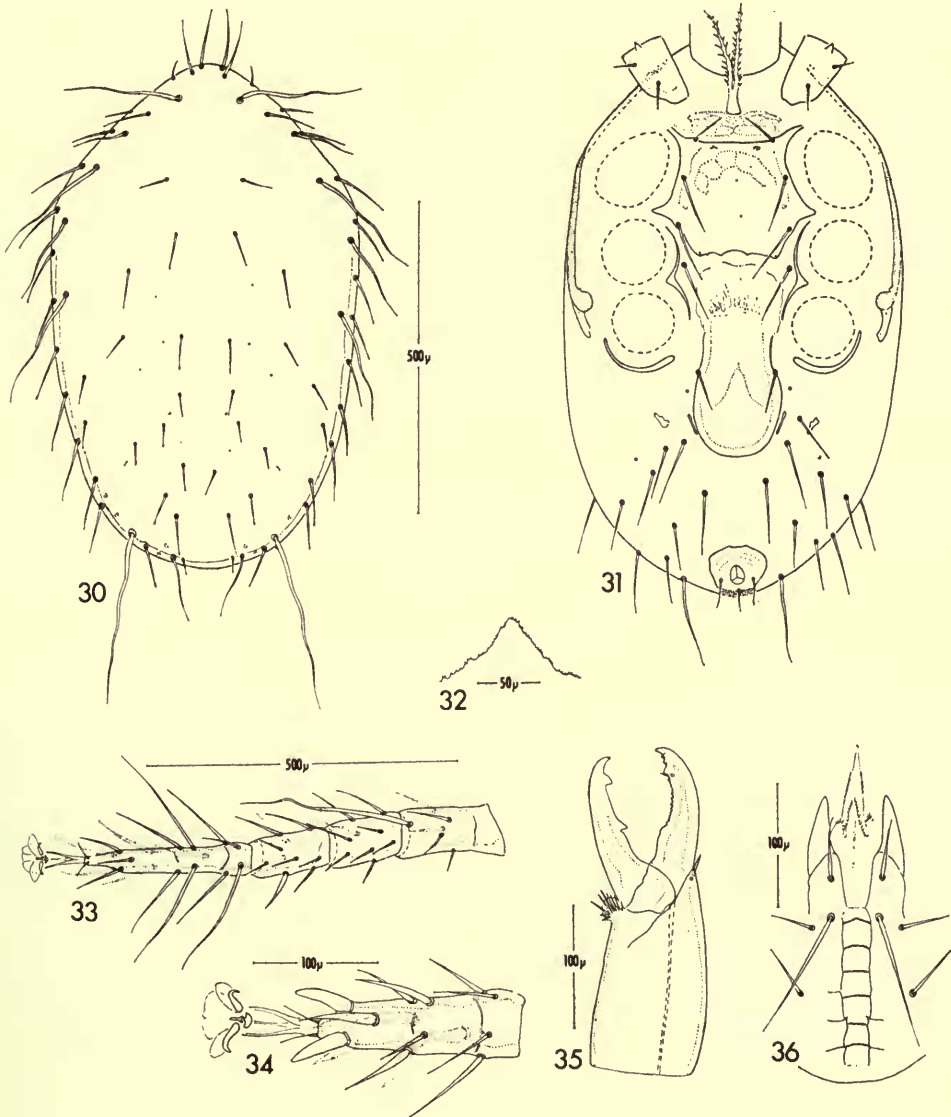
*Coleolaelaps rhinocerotis* Oudemans, 1927, *Zoöl. Meded. Leiden* 10 (4) : 189-193, figs 8-15.

**FEMALE:** Dorsum covered by a single dorsal shield (770-830  $\mu\text{m}$  long and 470-540  $\mu\text{m}$  wide), with 37 pairs of simple setae. Setae  $s_{11}$  subequal in length with vertical setae ( $i_{11}$ ); the longest podonotal setae being  $i_2$ ,  $s_4-6$  ( $s_5$  being shorter than either  $s_4$  or  $s_6$ ). The central dorsal setae, especially on the opisthonotum are short and do not extend to the bases of the consecutive setae. Setae  $Z_4$  are the longest dorsal setae (300  $\mu\text{m}$ ), setae  $J_5$  are short (30  $\mu\text{m}$ ). The distribution and the relative lengths of the setae are shown in fig. 30. Tectum (fig. 32) triangular with denticulate margin.

Tritosternum normal with well developed laciniae. Sternal shield (170  $\mu\text{m}$  long and 185  $\mu\text{m}$  wide at  $St_2$ ) only slightly ornamented.  $St_{11}$  distinctly shorter than  $St_{2-4}$  which are long and extend markedly beyond the bases of the consecutive setae (fig. 31). The posterior margin of the shield is irregular. Genital shield (distance between genital setae 130  $\mu\text{m}$ ) tongue-shaped and nearly devoid of orna-mentation. Metapodal shields narrow and irregular. Anal shield small, postanal seta distinctly shorter than paranal setae. Peritreme extends anteriorly slightly beyond the middle of coxa I, it is free anteriorly and posteriorly.

Gnathosoma (fig. 36) with well-sclerotized corniculi and fimbriate internal malae, six rows of deutosternal denticles (12-18 per row). Chelicera (fig. 35) with bidentate movable digit with a large distance between the two teeth, fixed digit slightly curved and sickle shaped with one stout tooth and about 12 small denticles.

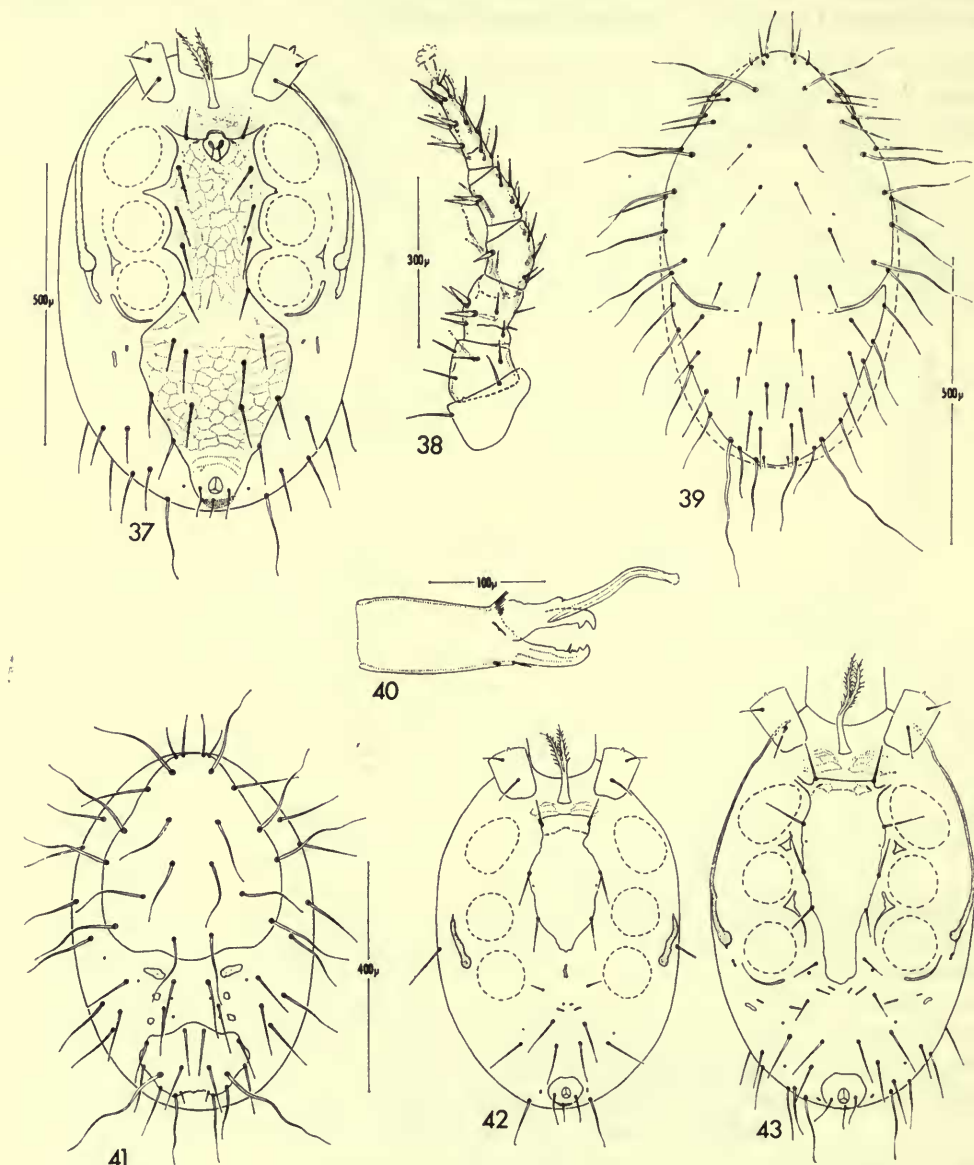
The approximate lengths of the legs (excluding pretarsi) are: I—750  $\mu\text{m}$ ; II—660  $\mu\text{m}$ ; III—700  $\mu\text{m}$ ; IV—950  $\mu\text{m}$ . Tarsus II (fig. 34) with two dorsal blunt spines, its ventral setae being much stouter than its dorsal setae. Leg IV (fig. 33) with macrosetae on femur (270  $\mu\text{m}$ ) and tarsus only,  $ad_1$  of the genu being only slightly longer than the remaining setae on the segment. Macrosetae are present also on femora II and III. Leg chaetotaxy normal. Leg chaetotaxy normal.



FIGS 30–36. *Hypoaspis rhinocerotis* Oudemans, female. Fig. 30. Dorsal shield. Fig. 31. Venter. Fig. 32. Tectum. Fig. 33. Leg IV. Fig. 34. Tarsus II. Fig. 35. Chelicera. Fig. 36. Gnathosoma, ventral view.



MALE: Dorsal shield smaller (740  $\mu\text{m}$  long and 480  $\mu\text{m}$  wide) than in female, with the same chaetotaxy. The venter (fig. 37) is covered by a well-ornamented holovenral shield with 10 pairs of setae in addition to the regular anal setae. Remaining ventral features as in female.



FIGS 37-43. *Hypoaspis rhinocerotis* Oudemans. Male, Fig. 37. Venter. Fig. 38. Leg II. Fig. 40. Chelicera. Deutonymph. Fig. 39. Dorsal shield. Fig. 43. Venter. Protonymph. Fig. 41. Dorsum. Fig. 42. Venter.



Movable digit of chelicera (fig. 40) monodentate with long slender spermadactyl which is distally curved. Fixed digit with about 4 teeth. Leg chaetotaxy as in female, leg II (fig. 38) with several stout pointed spine-like setae on femur to tarsus, similar to the condition found in *H. krameri* (as figured by Evans & Till, 1966).

DEUTONYMPH: Dorsal shield (670  $\mu\text{m}$  long and 380  $\mu\text{m}$  wide) deeply incised laterally, chaetotaxy and other features as in female although several central setae are longer (fig. 39). Sternal shield (fig. 43) extends only slightly beyond the posterior margin of coxa IV. A number of small platelets are present on the integument. Remaining characters as in female.

PROTONYMPH: The idiosoma (660  $\mu\text{m}$  long) is covered by two dorsal shields and three pairs of platelets in the mesonotal region. The podonotal shield (365  $\mu\text{m}$  long and 325  $\mu\text{m}$  wide) with 11 pairs of long setae all of which extend beyond the bases of consecutive setae. The opisthonotal shield with 8 pairs of setae, S<sub>5</sub>, Z<sub>4-5</sub> and J<sub>5</sub> having the same relative lengths as in the adult. The distribution and relative lengths of the setae are shown in fig. 41. The venter (fig. 42) with a sternal shield with 3 pairs of setae. Peritremes rudimentary.

DIFFERENTIAL DIAGNOSIS: The short central dorsal setae and the large sickle-shaped chelicera separate *H. rhinocerotis* from the preceding species. Associated with *Oryctes rhinoceros* L. (Scarabaeidae: Dynastinae).

MATERIAL: Numerous specimens, ex *Oryctes rhinoceros*, Apia, W. Samoa, July, 1969; additional specimens from eggs of *O. rhinoceros* and laboratory cultures. All the specimens were made available through the courtesy of Mr B. Zelazny and Dr M. J. Stelzer.

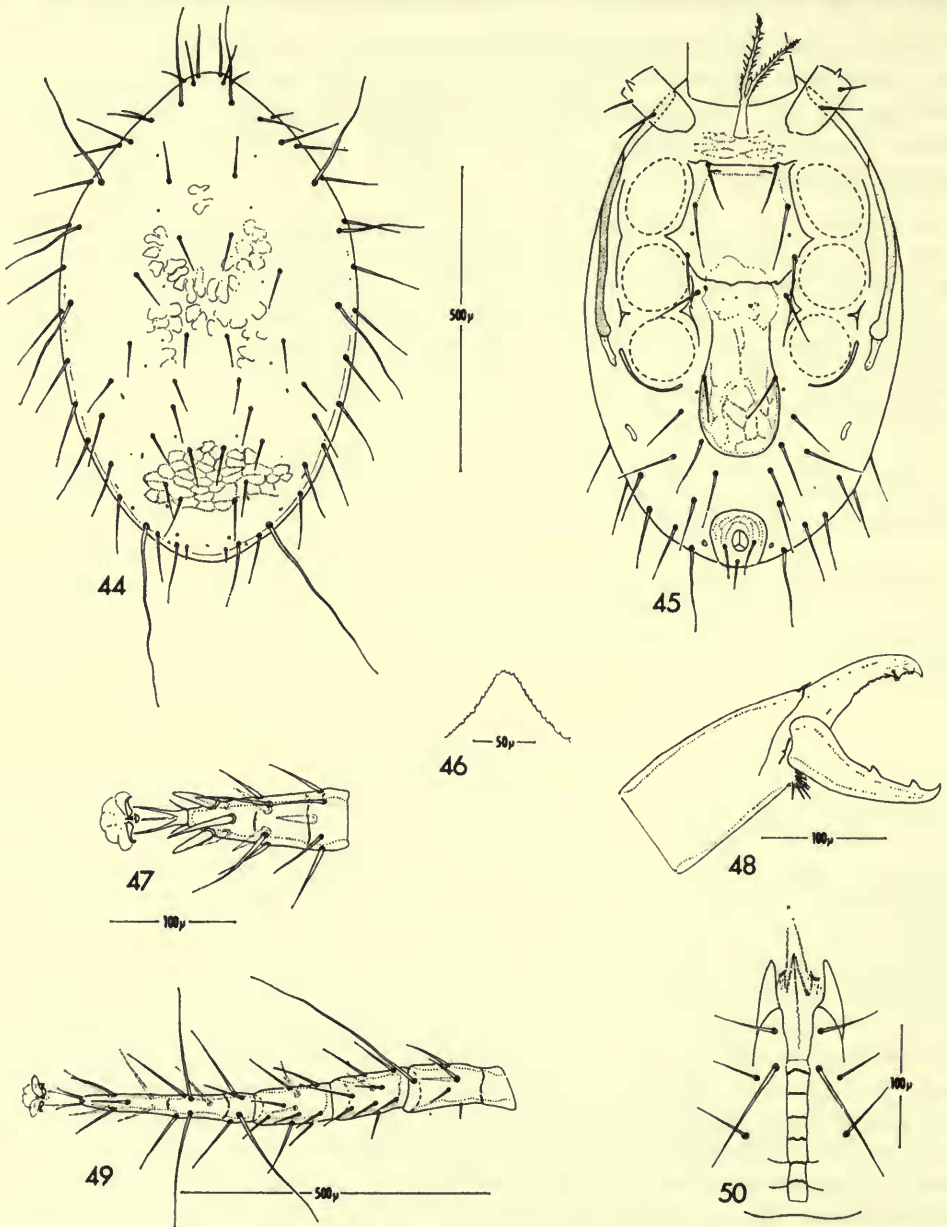
### *Hypoaspis athiasae* sp. n.

FEMALE: Dorsal shield (770–820  $\mu\text{m}$  long and 490–510  $\mu\text{m}$  wide) covers most of the dorsum, with 37 pairs of setae. The shield is slightly ornamented, mainly on its posterior part. Setae i<sub>2</sub>, s<sub>4-6</sub> are the longest podonotal setae, s<sub>5</sub> being markedly shorter than either s<sub>4</sub> or s<sub>6</sub>. Setae Z<sub>4</sub> are the longest dorsal setae (280  $\mu\text{m}$ ), J<sub>5</sub> are short (30  $\mu\text{m}$ ). The distribution and the relative lengths of the setae are shown in fig. 44. Tectum (fig. 46) triangular with denticulate margin.

Tritosternum with well-developed laciniae. Sternal shield (195  $\mu\text{m}$  long and 175  $\mu\text{m}$  wide at St<sub>2</sub>) without apparent ornamentation, with long sternal setae which extend beyond the base of the consecutive setae. Posterior margin of shield nearly straight and slightly irregular. Genital shield (distance between genital setae 120  $\mu\text{m}$ ) tongue-shaped and well ornamented. Narrow, kidney-shaped metapodal shields. The wide peritreme extends anteriorly to the anterior margins of coxa I. The postanal seta is shorter than the paranal setae.

Gnathosoma (fig. 50) with well-sclerotized corniculi and fimbriate internal malae, with six rows of deutosternal denticles (10–14 per row). Movable digit of chelicera (fig. 48) bidentate, fixed digit with about 14 small denticles in addition to a larger tooth which is associated with the pilus dentilis.

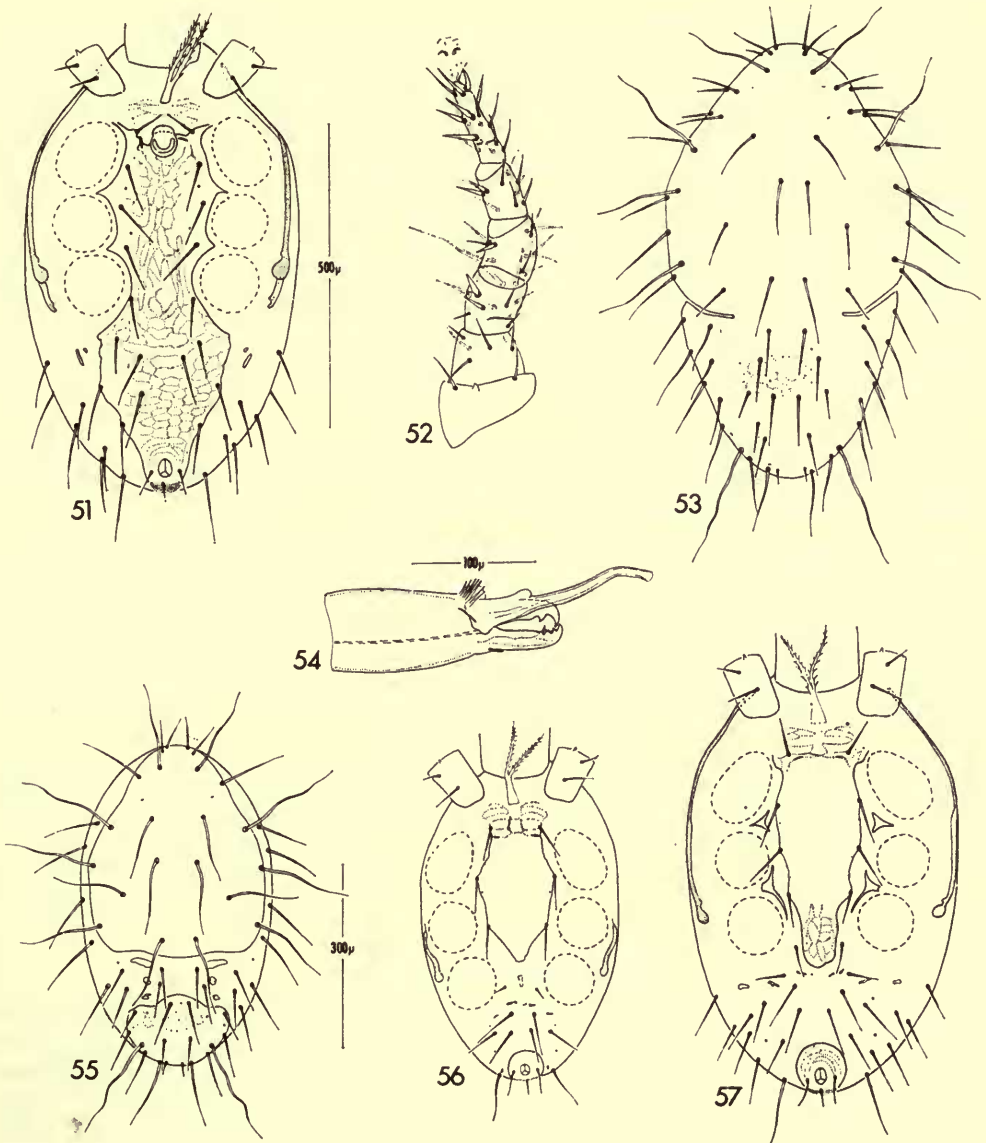
The approximate lengths of the legs (excluding pretarsi) are: I—840  $\mu\text{m}$ ; II—675  $\mu\text{m}$ ; III—710  $\mu\text{m}$ ; IV—800  $\mu\text{m}$ . Tarsus II (fig. 47) with two dorsal distal blunt spines. Leg IV (fig. 49) with macrosetae on femur (280  $\mu\text{m}$ ) and tarsus



FIGS 44-50. *Hypoaspis athiasae* sp. n., female. Fig. 44. Dorsal shield. Fig. 45. Venter. Fig. 46. Tectum. Fig. 47. Tarsus II. Fig. 48. Chelicera. Fig. 49. Leg IV. Fig. 50. Gnathosoma, ventral view.

only,  $ad_1$  of the genu being only slightly longer than the remaining setae of the segment. Macrosetae also present on femora II and III.

MALE: The dorsal shield (815  $\mu\text{m}$  long and 485  $\mu\text{m}$  wide) and chaetotaxy as in female. Ventrally the idiosoma is covered by a well-ornamented holovenal



FIGS 51-57. *Hypoaspis athiasae* sp. n. Male, Fig. 51. Venter. Fig. 52. Leg II. Fig. 54. Chelicera. Deutonymph, Fig. 53. Dorsal shield. Fig. 57. Venter. Protonymph, Fig. 55. Dorsum. Fig. 56. Venter.

shield, usually with 10 pairs of setae in addition to the regular anal setae (fig. 51). The extent and outlines of the shield may vary asymmetrically and with it the chaetotaxy. The chelicera (fig. 54) with monodontate movable digit which bears a long slender spermadactyl, slightly curved distally. Leg II with pointed spine-like setae on femur to tarsus (fig. 52), similar to the condition in *H. krameri* (Evans & Till, op. cit.).

**DEUTONYMPH:** Dorsal shield (715  $\mu\text{m}$  long and 400  $\mu\text{m}$  wide) deeply incised laterally. Chaetotaxy similar to that of the female, central setae (mainly i series) noticeably long. The shield is faintly ornamented mainly on its posterior portion. The distribution and relative lengths of the setae is shown in fig. 53. The anal shield is rounded and the postanal seta is markedly shorter than the paranal setae (fig. 57).

**PROTONYMPH:** The idiosoma (530  $\mu\text{m}$  long) is covered by two dorsal shields and three pairs of platelets in the mesonotal region. The podonotal shield (350  $\mu\text{m}$  long and 290  $\mu\text{m}$  wide) with 11 pairs of long setae. The opisthonotal shield (120  $\mu\text{m}$  long and 170  $\mu\text{m}$  wide) with 8 pairs of setae. Setae S5, Z4-5 and J5 have the same relative lengths as in the adult. The distribution and the relative lengths of the setae are shown in fig. 55. The venter (fig. 56) with small sternal shield which has a very indistinct anterior margin.

**DIFFERENTIAL DIAGNOSIS:** This species is closely related to *H. rhinocerotis* from which it can be separated mainly by its longer central dorsal setae, a character which is even more conspicuous in the deutonymph.

**NOTES:** This species has been collected in large numbers (by Dr C. Athias-Henriot) from soil as well as from eggs of *O. monoceros* in the Ivory Coast. It is well known that many dynastine beetles emerge from their puparia during a few days of the year only, usually for a short time before dusk. It may well be that the possibility to collect a large number of the mites from the soil happened after a mass emergence of the beetles which are probably their normal host.

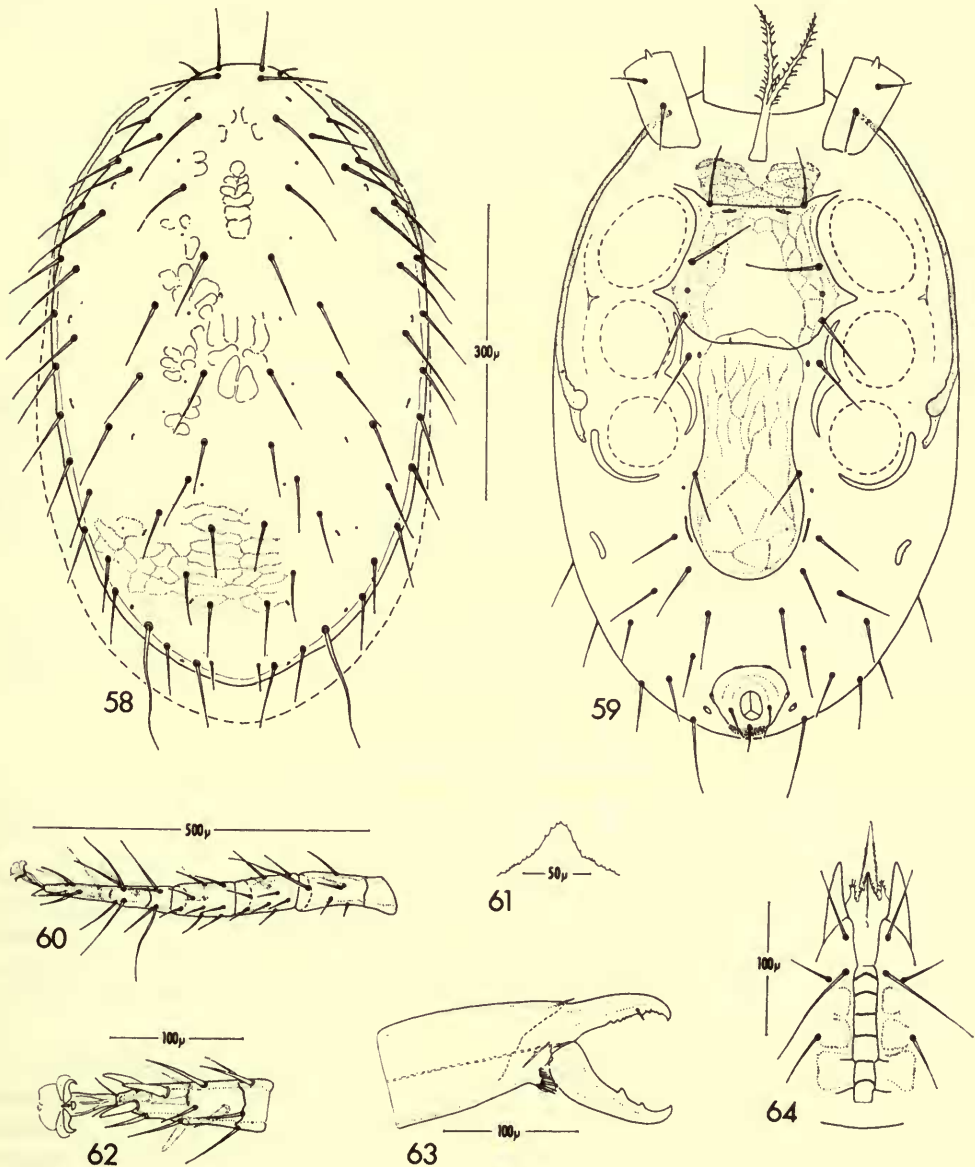
**MATERIAL:** Holotype: ♀, ex humid soil (Aerodrome), Ivory Coast, July 18, 1969, coll. C. Athias-Henriot. Paratypes: 1 ♂ and numerous female specimens *ibid.*; 5 ♀♀ *Oryctes monoceros*, Ivory Coast, 1969.

### *Hypoaspis dubius* sp. n.

**FEMALE:** Dorsum covered by a single dorsal shield (640  $\mu\text{m}$  long and 380  $\mu\text{m}$  wide), with 37 pairs of simple setae. The shield is finely ornamented mainly on its posterior part. Setae i2, s1 and s4-6 are longer than the remaining podonotal setae, the longest dorsal setae are Z4 (130  $\mu\text{m}$ ), the shortest J5 (25  $\mu\text{m}$ ). Nearly all the central setae are long and extend beyond the base (or the horizontal level of the bases) of the consecutive setae. The distribution and the relative lengths of the setae are shown in fig. 58. Tectum (fig. 61) triangular with denticulate margin.



Tritosternum normal with pilose laciniae. Sternal shield (135  $\mu\text{m}$  long and 140  $\mu\text{m}$  wide at St2) faintly ornamented mainly in its anterior and lateral parts, posterior margin slightly concave to nearly straight. St1 shorter than remaining sternal setae which are long and extend beyond the base of consecutive setae. The tongue-



FIGS 58-64. *Hypoaspis dubius* sp. n., female. Fig. 58. Dorsal shield. Fig. 59. Venter. Fig. 60. Leg IV. Fig. 61. Tectum. Fig. 62. Tarsus II. Fig. 63. Chelicera. Fig. 64. Gnathosoma, ventral view.



shaped genital shield (distance between genital setae 105  $\mu\text{m}$ ) is faintly ornamented (fig. 59). Metapodal shields narrow and elongate. The postanal seta is shorter than the paranal setae. The peritreme extends anteriorly slightly beyond the middle of coxa I.

Gnathosoma (fig. 64) with well-sclerotized corniculi and fimbriate inner malae, six rows of deutosternal denticles (14–18 per row). Movable digit of chelicera (fig. 63) bidentate, fixed digit with about 8 small denticles in addition to one larger tooth.

The approximate lengths of the legs (excluding pretarsi) are: I—640  $\mu\text{m}$ ; II—490  $\mu\text{m}$ ; III—490  $\mu\text{m}$ ; IV—690  $\mu\text{m}$ . Tarsus II (fig. 62) with two dorsal distal blunt spines. Leg IV (fig. 60) with macrosetae on the femur (145  $\mu\text{m}$ ) and tarsus only. Macrosetae are present also on femora II and III.

MALE: Unknown.

DIFFERENTIAL DIAGNOSIS: This species is characterized by its small size and short  $Z_4$  and  $ad_1$  of femur IV.

NOTES: The status of this species is uncertain and it might be a hybrid. Originally it was introduced from the Ivory Coast, ex *Oryctes monoceros*. It has become established in W. Samoa and occurred together with *H. rhinocerotis* on a field-collected *O. rhinoceros* (coll. Dr M. J. Stelzer). In view of the fact that *Hypoaspis athiasae* sp. n. has also been collected from *O. monoceros*, a misdetermination of the African host cannot be ruled out, since over a dozen species of *Oryctes* exist in central and western Africa.

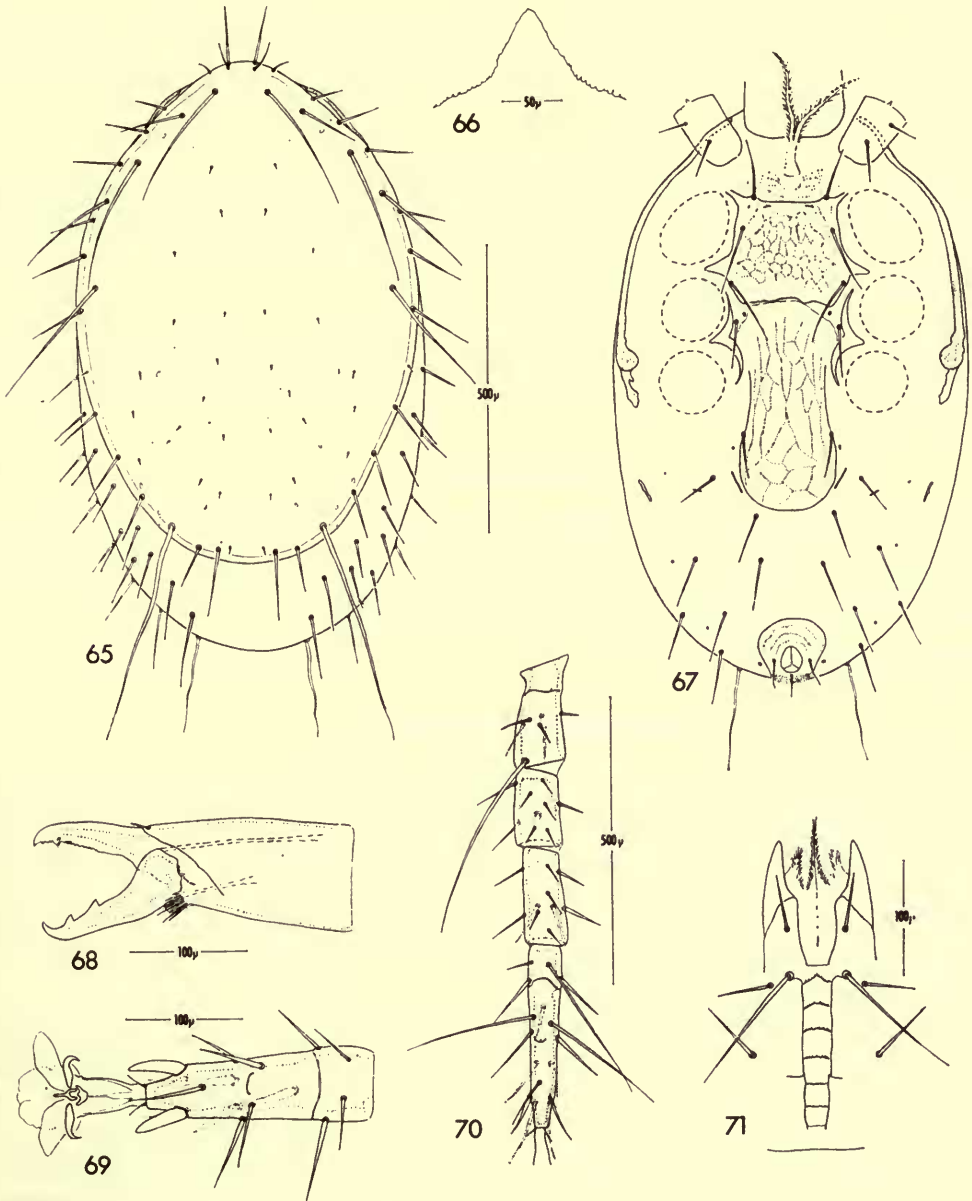
MATERIAL: Holotype: ♀, laboratory reared, Apia, W. Samoa, July 1969, laboratory colony started from specimens ex *Oryctes monoceros*, Ivory Coast. Paratypes: many *ibid.*; 6 ♀♀, *O. rhinoceros*, Apia, W. Samoa, Sept. 1969, coll. Dr M. J. Stelzer.

### *Hypoaspis remilleti* sp. n.

FEMALE: Dorsum covered by single dorsal shield (870  $\mu\text{m}$  long and 560  $\mu\text{m}$  wide) leaving a wide strip of uncovered integument. The shield bears 36 pairs of setae (s3 missing, compare *Hypoaspis phyllognathi* sp. n.) of three different types: minute setae (about 20  $\mu\text{m}$  long: i3–5, z2–3, J series px2–3, Z1–3 and S1); extremely long setae (i2, s4–6 and  $Z_4$  which are 400  $\mu\text{m}$  long) and 'normal' marginal setae. The posterior elongate integumental setae are only 180  $\mu\text{m}$  long. The distribution and the relative lengths of the setae are shown in fig. 65. Tectum (fig. 66) triangular with denticulate margin.

Tritosternum normal with pilose laciniae. Sternal shield (160  $\mu\text{m}$  long and 170  $\mu\text{m}$  wide at St2) ornamented, with irregular posterior margin (fig. 67). The sternal setae are long, extending beyond the bases of the consecutive setae. The well-ornamented genital shield (distance between genital setae 150  $\mu\text{m}$ ) expands slightly beyond coxae IV. Anal shield with round anterior margin, postanal seta shorter than paranal setae. The peritreme extends anteriorly to or slightly beyond the anterior margin of coxa I, it is free both anteriorly and posteriorly.

Gnathosoma (fig. 71) with well-sclerotized corniculi and fimbriate internal malae, six rows of minute deutosternal denticles. Movable digit of chelicera (fig. 68) bidentate, fixed digit with about 12 small denticles in addition to one larger tooth.



FIGS 65-71. *Hypoaspis remilleti* sp. n., female. Fig. 65. Dorsum. Fig. 66. Tectum. Fig. 67. Venter. Fig. 68. Chelicera. Fig. 69. Tarsus II. Fig. 70. Leg IV. Fig. 71. Gnathosoma, ventral view.

The approximate lengths of the legs (excluding pretarsi) are: I—890  $\mu\text{m}$ ; II—740  $\mu\text{m}$ ; III—800  $\mu\text{m}$ ; IV—1100  $\mu\text{m}$ . Tarsus II (fig. 69) with two blunt dorsal subterminal spines. Leg IV (fig. 70) with macrosetae on the femur (380  $\mu\text{m}$ ) and tarsus only. Leg chaetotaxy normal.

**MALE:** Dorsal shield as in female. The venter is covered by a holoverntal shield with 10 pairs of setae in addition to the regular anal setae. Leg II with pointed spine-like ventral setae on femur to tarsus. Chelicera with slender spermodactyl, distally curved.

**DIFFERENTIAL DIAGNOSIS:** This species can be easily recognized by its very short central setae and its long antero-lateral setae. It differs from closely related '*Coleolaelaps proximus* Cooreman, 1948 mainly in the shape of the sternal shield which is markedly longer than wide in *C. proximus*. Associated with *Heteroligus meles* Billb. (Scarabaeidae: Dynastinae).

**MATERIAL:** Holotype: ♀, ex *Heteroligus meles* Billb., nr. Abidjan, Ivory Coast, 1969, coll. Dr M. Remillet. Paratypes: numerous specimens including males with the same data.

### *Lucanaspis* gen. n.

General facies of female as in *Hypoaspis* with the following differences: Thirty-three pairs of dorsal setae of which  $i_2$ ,  $s_4$  and  $Z_4$  are very long. Sternal shield markedly wider than long. Legs stumpy and shorter than length of dorsal shield. Tarsus II with two subterminal stout and pointed setae.

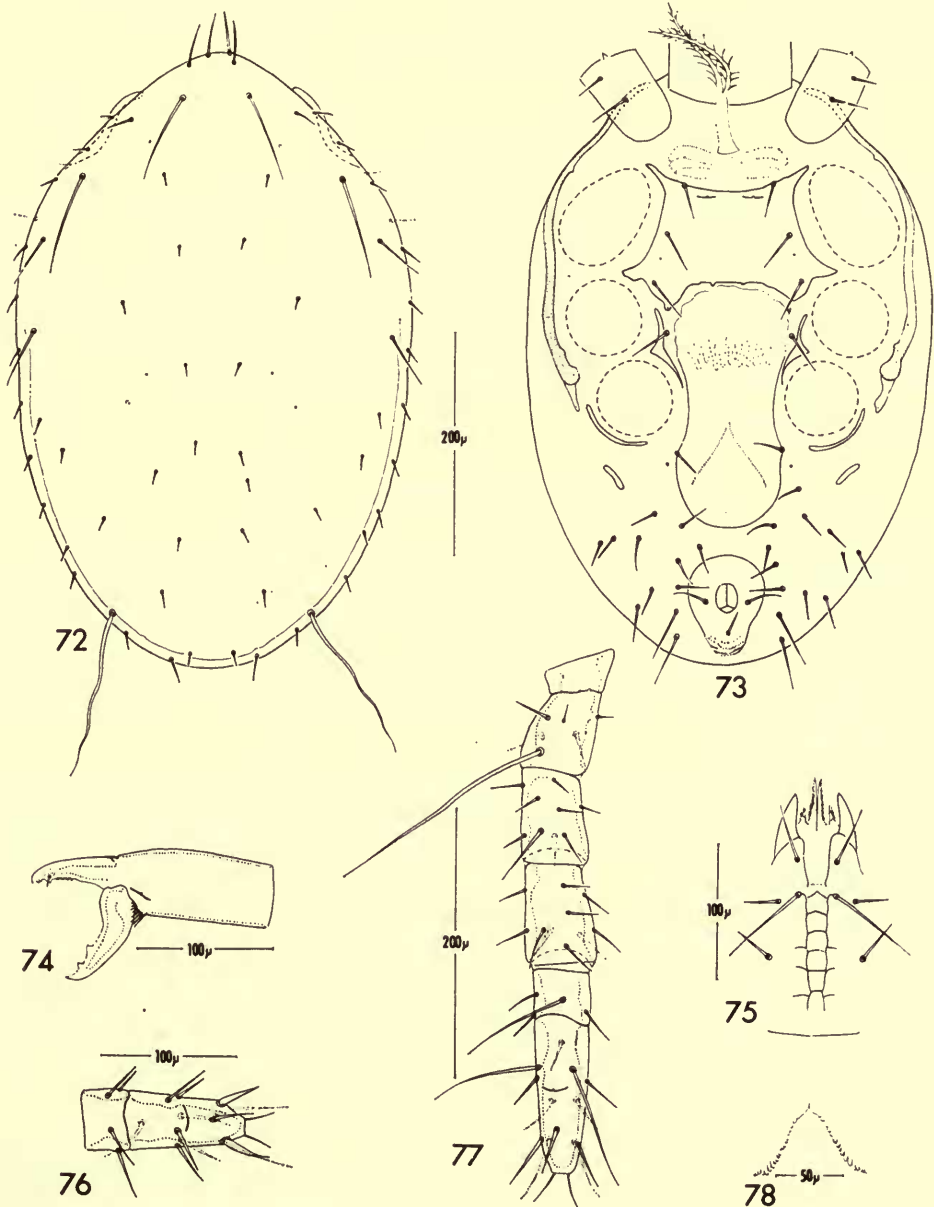
**MALE:** Unknown.

### *Lucanaspis brachypedes* sp. n.

**FEMALE:** Dorsum covered by a single dorsal shield (545  $\mu\text{m}$  long and 360  $\mu\text{m}$  wide), devoid of ornamentation, with 33 pairs of simple setae. The podonotal setae (17 pairs) are very short (10–15  $\mu\text{m}$ ) with the exception of  $i_1$  and  $s_1$  (85  $\mu\text{m}$ ),  $i_2$ ,  $s_4$  (120  $\mu\text{m}$ ),  $s_5$  and  $s_6$  (60  $\mu\text{m}$ ). The opisthonotal setae (16 pairs) are short with the exception of  $Z_4$  (155  $\mu\text{m}$ ) which are the longest dorsal setae. The distribution and the relative lengths of the setae are shown in fig. 72. Tectum (fig. 78) triangular with denticulate margins.

Tritosternum normal with pilose laciniae. Sternal shield (75  $\mu\text{m}$  long and 130  $\mu\text{m}$  wide at  $St_2$ ) with distinct anterior concave margin and slightly irregular concave posterior margin. The shield is devoid of distinct ornamentation. The first sternal pores are very large and close to each other. Metasternal setae inserted on the integument, the associated pore may be incorporated into the sternal shield (fig. 73). Genital shield (distance between genital setae 95  $\mu\text{m}$ ) broad and tongue-shaped. Anterior margin of anal shield semicircular, paranal setae slightly longer than postanal seta. The shield is flanked by two pairs of slightly longer and stouter ventral setae. Metapodal shields elongate, oval. The peritreme extends anteriorly nearly to the anterior margin of coxa I, it is free both anteriorly and posteriorly.

Gnathosoma (fig. 75) with well-sclerotized corniculi and fimbriate internal malae, with six rows of tiny deutosternal denticles. Movable digit of the chelicera (fig. 74) bidentate, fixed digit with three medium sized distal teeth and about seven small proximal denticles.



FIGS 72-78. *Lucanaspis brachypedes* gen. n., sp. n., female. Fig. 72. Dorsal shield. Fig. 73. Venter. Fig. 74. Chelicera. Fig. 75. Gnathosoma, ventral view. Fig. 76. Tarsus II. Fig. 77. Leg IV. Fig. 78. Tectum.



The approximate lengths of the legs (excluding pretarsi) are: I—520  $\mu\text{m}$ ; II—450  $\mu\text{m}$ ; III—440  $\mu\text{m}$ ; IV—540  $\mu\text{m}$ . Leg chaetotaxy normal as in free-living laelapids. Macrosetae are present on femora II–IV (on femur IV—165  $\mu\text{m}$ ) and tarsus IV (fig. 77). Tarsus II (fig. 76) with two subterminal pointed stout setae.

**MATERIAL:** Holotype: ♀, ex lucanid beetle, nr. Abidjan, Ivory Coast, Oct. 1969, coll. Dr M. Remillet. Paratypes: 8 ♀♀, same data.

### *Dynastaspis* gen. n.

General facies of female as in *Hypoaspis* with the following differences: 32 pairs of dorsal setae (18 podonotal and 14 opisthonotal) with s4–6 and Z4 very long and 'wavy'. Tectum with nondenticulate margin. Four macrosetae of a different homology on tarsus IV: *ad*<sub>2</sub>, *al*<sub>3</sub>, *pl*<sub>2</sub> and *pd*<sub>3</sub> (instead of *pd*<sub>2</sub>, *pd*<sub>3</sub> and *ad*<sub>2</sub> in *Hypoaspis* s. str.), *pd*<sub>2</sub> being proximally inserted to *ad*<sub>2</sub> (as distinct from being at the same level in *Hypoaspis* s. str.). Tarsus II with two subterminal pointed stout setae. Ornamentation of genital shield different from that found in *Hypoaspis*.

**MALE:** Unknown.

### *Dynastaspis walhallae* sp. n.

**FEMALE:** A single dorsal shield (1030  $\mu\text{m}$  long and 580  $\mu\text{m}$  wide) covers the dorsum incompletely, faintly ornamented with a scale-like pattern (fig. 86), with 32 pairs of simple setae (fig. 79). Eighteen pairs of podonotal setae, z3 absent, s7 on the integument and 14 pairs of opisthonotal setae (S4 and px2–3 absent). Medial setae mainly short (e.g. i4—45  $\mu\text{m}$ ), s4–6 long and 'wavy', Z4 being the longest dorsal setae (400  $\mu\text{m}$ ). Tectum (fig. 83) with nondenticulate margin and broad median projection.

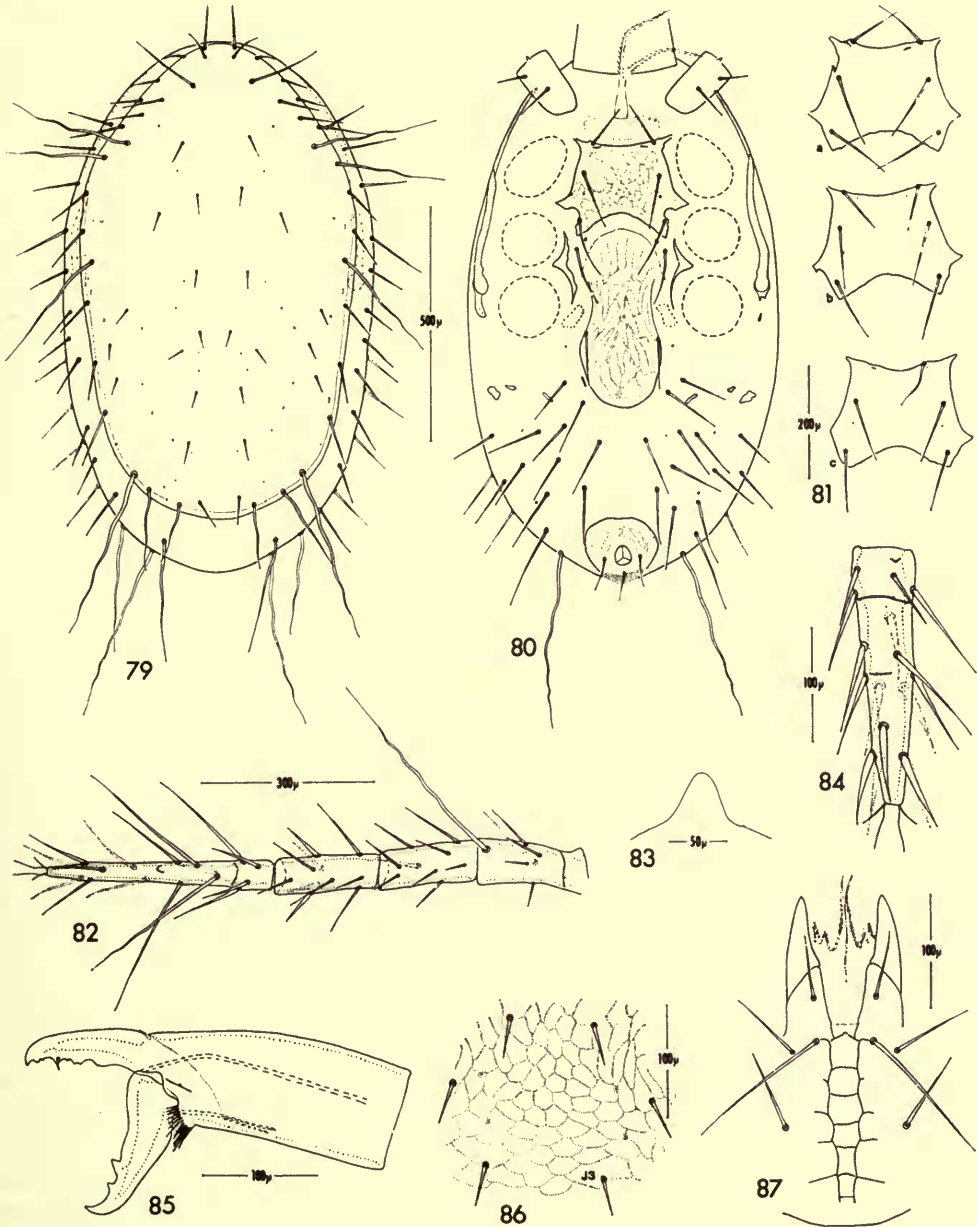
Tritosternum normal with pilose laciniae. Sternal shield (140  $\mu\text{m}$  long and 195  $\mu\text{m}$  wide at St2), well ornamented with concave anterior margin and deeply concave posterior margin (fig. 80, 81a–c). Sternal setae long, St2 extending beyond posterior margin of shield. The shape of the sternal shield is variable, mainly in the lateral outlines (figs 81a–c, in 81c one St1 completely missing). Genital shield (distance between genital setae 155  $\mu\text{m}$ ) tongue-shaped, with very distinct ornamentation which is completely different from that found in species of *Hypoaspis* s. str. Metapodal shields small and irregular, several small platelets present at the same level. Anal shield nearly triangular in shape, postanal seta shorter than the paranal setae. The peritreme extends anteriorly slightly beyond the posterior margin of coxa I, it is free anteriorly and posteriorly.

Gnathosoma (fig. 87) with well-sclerotized corniculi and fimbriate internal malae, with six rows of deutosternal teeth (10–14 per row). Movable digit of the chelicera (fig. 85) bidentate, fixed digit with about eight denticles of different sizes and shapes.

The approximate lengths of the legs (excluding pretarsi) are: I—1010  $\mu\text{m}$ ; II—850  $\mu\text{m}$ ; III—870  $\mu\text{m}$ ; IV—1190  $\mu\text{m}$ . Tarsus II (fig. 84) with pointed setae only, leg IV (fig. 82) with macrosetae on femur (400  $\mu\text{m}$ ) and four macrosetae (*ad*<sub>2</sub>, *al*<sub>3</sub>,



$pl_2$ ,  $pd_3$ ) on the tarsus with  $pd_2$  proximally inserted. Otherwise leg chaetotaxy normal.



FIGS 79-87. *Dynastaspis walhallae* gen. n., sp. n., female. Fig. 79. Dorsum. Fig. 80. Venter. Fig. 81a-c. Variations in shape of sternal shield. Fig. 82. Leg IV. Fig. 83. Tectum. Fig. 84. Tarsus II. Fig. 85. Chelicera. Fig. 86. Ornamentation of dorsal shield. Fig. 87. Gnathosoma, ventral view.

**MATERIAL:** Holotype: ♀, ex larvae of *Dynastes tytius* Linn. (Scarabaeidae: Dynastinae), dead Black Locust Tree, Walhalla, South Carolina, August 1969, coll. M. Palmer. Paratypes: 8 ♀♀, same data as type.

**NOTES:** The occurrence of this species on larvae of *Dynastes tytius* is rather surprising as Sikora (1968) reported a different species of '*Coleolaelaps*' from the adult of *D. tytius*. It may be that the host association of *D. walhallae* is accidental, the true host being another woodboring beetle.

### *Angosomaspis* gen. n.

**FEMALE:** Single dorsal shield with a large number (over 100) of minute (15–20 μm) setae, ventral integument with about 30 pairs of long, very attenuated whip-like setae. Macroseta of femur IV exceedingly long, extending beyond middle of tarsus IV, only one macroseta ( $pd_2$ ) on tarsus IV. Long macroseta also on femora II and III. Tarsus II with two subterminal spine-like setae which are originally pointed, though usually the tip is broken off, leaving a sharp (not blunt) end. Fixed digit of chelicera with about a dozen sharp, needle-shaped denticles proximal to the pilus dentilis. Remaining characters similar to *Hypoaspis*.

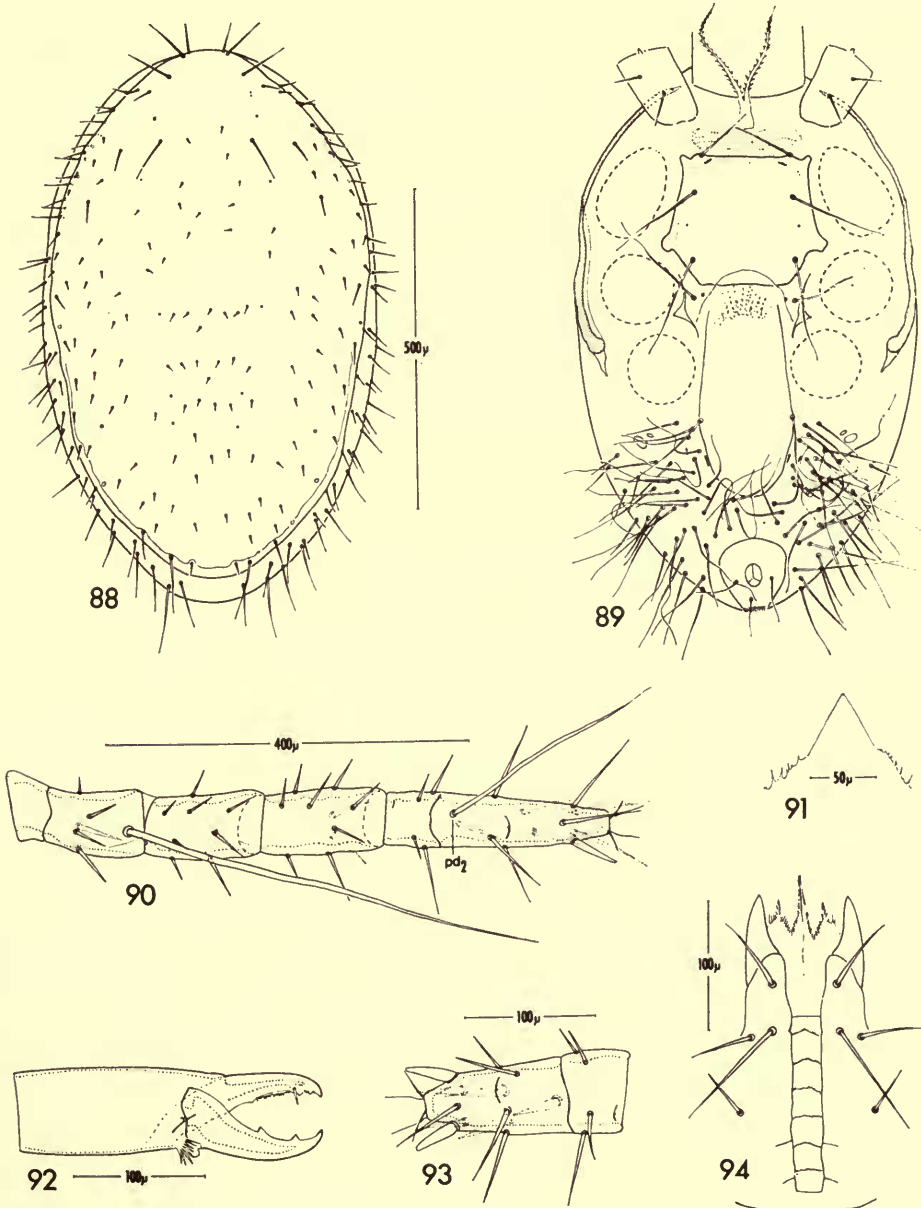
**MALE:** Unknown.

### *Angosomaspis multisetosus* sp. n.

**FEMALE:** Dorsum covered by single dorsal shield (800 μm long and 480 μm wide) covering most of the dorsum. Over a 100 minute setae (15–20 μm) are distributed on the shield, obscuring any paired arrangement. Only four pairs of anterior setae and one pair of posterior marginal setae are of 'normal' *Hypoaspis*-type length and appearance (60–95 μm). The distribution and the relative lengths of the setae are shown in fig. 88. The laterodorsal chaetotaxy is obscured by a row of setae which are inserted on the soft integument between the narrow peritrematal shield and the dorsal shield, in mounted specimens this part of the integument invariably folds below the dorsal shield and only the examination of the mite in lateral position reveals that these setae are not inserted on the shield. The dorsal shield is finely granulated but shows no ornamentation. Tectum (fig. 91) triangulate with margins partly or totally denticulate.

Tritosternum normal with long pilose laciniae. Sternal shield (190 μm long and 170 μm wide at St2) with straight anterior and posterior margin, finely granulated surface without ornamentation. Sternal setae long (e.g. St2—150 μm) and whiplike, very attenuated and coming to a fine end, they are similar to the remaining (about 30 pairs) ventral setae. Genital shield large and elongate (distance between genital setae 145 μm), devoid of ornamentation. Anal shield with slightly curved anterior margin, paranal setae longer than postanal seta. The peritreme extends anteriorly slightly beyond the middle of coxa I, it is accompanied by a very narrow external and internal peritrematal shield which is free both anteriorly and posteriorly.

Gnathosoma (fig. 94) with well-sclerotized corniculi and fimbriate internal malae with six rows of minute deutosternal denticles. Movable digit of chelicera (fig. 92) bidentate, fixed digit with about a dozen fine pointed denticles proximal to the pilus dentilis.



FIGS 88-94. *Angosomaspis multisetosus* gen. n., sp. n., female. Fig. 88. Dorsum. Fig. 89. Venter. Fig. 90. Leg IV. Fig. 91. Tectum. Fig. 92. Chelicera. Fig. 93. Tarsus II. Fig. 94. Gnathosoma, ventral view.

The approximate lengths of the legs (excluding pretarsi) are: I—760  $\mu\text{m}$ ; II—650  $\mu\text{m}$ ; III—680  $\mu\text{m}$ ; IV—890  $\mu\text{m}$ . Long macrosetae on femora II–IV,  $ad_1$  of femur IV (490  $\mu\text{m}$ ) extending beyond the middle of the corresponding tarsus. Only one macroseta ( $pd_2$ ) on tarsus IV (fig. 90). Tarsus II (fig. 93) with two sub-terminal pointed spine-like setae, usually the tip is broken off leaving a sharp jagged surface.

**MATERIAL:** Holotype: ♀, ex *Angosoma centaurus* (Scarabaeidae: Dynastinae), nr. Abidjan, Ivory Coast, 1969, coll. Dr M. Remillet. Paratypes: 20 ♀♀, same data as type.

### *Promacrolaelaps* gen. n.

**FEMALE:** Large mites with a convex dorsal shield which covers the sides and the dorsum. Thirty-one pairs (17 podonotal and 14 opisthonotal) of long setae are inserted on the shield. Genital shield large, expanded posterior to the genital setae. Macrosetae present on femora I–IV, genua III–IV and single macroseta on tarsus IV. Tarsus II without spine-like or spur-like setae. Gnathosoma with seven rows of deutosternal denticles, fixed digit of chelicera with six medium-sized sharp teeth proximal to the pilus dentilis.

**MALE:** Unknown.

### *Promacrolaelaps hunteri* sp. n.

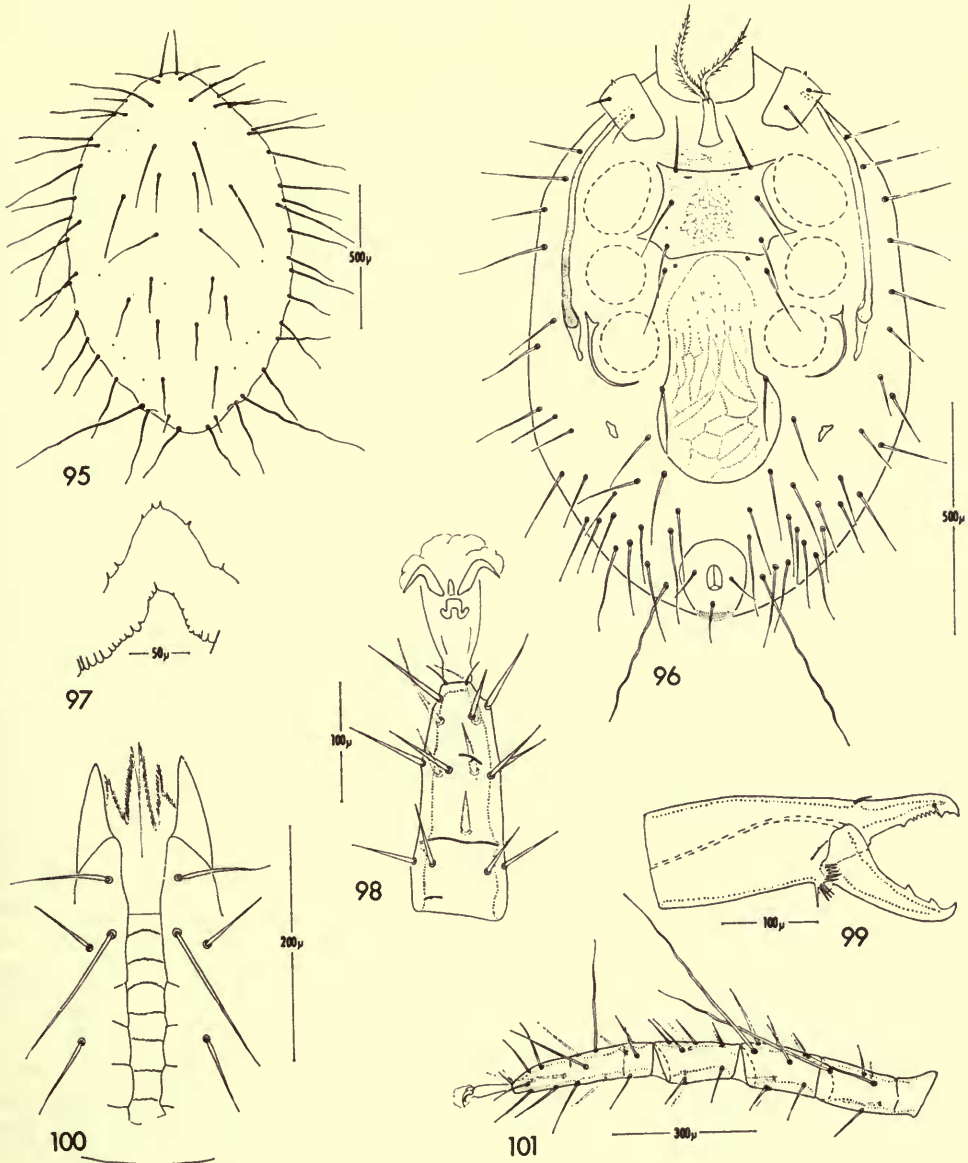
**FEMALE:** The dorsum is completely covered by a large convex dorsal shield (1260  $\mu\text{m}$  long and 820  $\mu\text{m}$  wide) which covers the mite also laterally. Thirty-one pairs of simple long setae (17 podonotal and 14 opisthonotal) are inserted on the shield. Setae Z4 are the longest (510  $\mu\text{m}$ ) dorsal setae. The shape of the shield as well as the lateral displacement of many setae did not permit positional homologization of most setae, their distribution and relative lengths being shown in fig. 95. Tectum (fig. 97) with denticulate margin.

Tritosternum normal, with pilose laciniae. Sternal shield (170  $\mu\text{m}$  long and 210  $\mu\text{m}$  wide at St2) wider than long, with long sternal setae extending considerably beyond the bases of consecutive setae. The shield is ornamented and granulate, its anterior and posterior margins are straight to slightly concave. Genital shield (fig. 96) large (distance between genital setae 220  $\mu\text{m}$ ), well ornamented and expanding posterior to the genital setae. Metapodal shields small and irregular. Anal shield with rounded anterior margin, postanal seta slightly longer than paranal setae. The anal shield is flanked by a pair of long (370  $\mu\text{m}$ ) setae. Approximately 17 pairs of setae are inserted on the integument posterior to coxae IV. The peritreme extends anteriorly beyond the middle of coxa I and is free both anteriorly and posteriorly.

Gnathosoma (fig. 100) with well-sclerotized corniculi and fimbriate internal malae, seven rows of deutosternal teeth (10–20 per row) are present. Movable digit of the chelicera (fig. 99) bidentate, fixed digit with six well-defined, medium-sized sharp teeth proximal to the pilus dentilis.



The approximate lengths of the legs (excluding pretarsi) are: I—980  $\mu\text{m}$ ; II—850  $\mu\text{m}$ ; III—830  $\mu\text{m}$ ; IV—930  $\mu\text{m}$ . Macrosetae present in femora I and II ( $pd_1$ ), III and IV ( $ad_1$ , 450  $\mu\text{m}$  long on femur IV); on genua III and IV ( $ad_1$ , 450  $\mu\text{m}$  long on genu IV) and a single macroseta ( $pd_2$ —250  $\mu\text{m}$ ) on tarsus IV (fig. 101).



FIGS 95–101. *Promacrolaelaps hunteri* gen. n., sp. n., female. Fig. 95. Dorsal shield. Fig. 96. Venter. Fig. 97. Tectum. Fig. 98. Tarsus II. Fig. 99. Chelicera. Fig. 100. Gnathosoma, ventral view. Fig. 101. Leg IV.



Tarsus II (fig. 98) with simple pointed setae only, the ventral setae being slightly stouter.

This species is named in honour of my friend and colleague Dr P. E. Hunter (Department of Entomology, The University of Georgia).

**MATERIAL:** Holotype: ♀, ex *Promacrus bimucronatus* Pallas (Scarabaeidae: Euchirinae), Tivon, Israel, August 20, 1967, coll. M. Costa. Paratypes: 5 ♀♀, same data as type.

#### DISCUSSION

The vague early definition of genera and species can often be applied to several different taxa subsequently discovered. In the present study the early descriptions and figures of *Hypoaspis krameri* Can. apply equally well to *H. krameri* Can. sensu Evans & Till (1966), *H. neokrameri* sp. n.; *H. pentodoni* sp. n.; *H. phyllognathi* sp. n.; *H. integer* Berlese sensu Samšičák (1960), etc. Vitzthum (1940-43) records '*H. krameri*' from the following hosts: *O. nasicornis*, *Cetonia aurata*, *Potosia floricola*, *Pentodon punctatus*, *Polyphylla fullo*—apparently placing under *H. krameri* several species with a higher degree of host specificity than assumed by him. The uncertainty of the determination of mites of the *Hypoaspis* and *Coleolaelaps* complexes by Berlese has been discussed by Costa & Hunter (op. cit.). In view of this early species confusion and the fact that their material was obtained from a new host, namely *Lucanus* sp., it seems rather uncertain that *H. krameri* Can. sensu Evans & Till is actually conspecific with the type species, it undoubtedly agrees with the description and definition of *Hypoaspis* s. str. However, in order to avoid additional confusion on the subject, the decision made by Evans & Till is accepted here until the type (? lost) or topotypic material from the type host can be examined. The definition of *Hypoaspis* s. str. as conceived here, as well as the definition of *Coleolaelaps* Berl. as conceived by Costa & Hunter (op. cit.) will necessitate the transfer of many species from the latter genus to *Hypoaspis* s. str., this being, however, outside the scope of the present study.

Being convinced that host-association is just as good a character for taxonomic discrimination as morphological characters, I have designated four new genera of which the first two (*Lucanaspis* and *Dynastaspis*) are closer related to *Hypoaspis* s. str. than the remaining two (*Angosomaspis* and *Promacrolaelaps*). As additional species are expected for these genera, the generic definitions are short and not very rigorous, allowing amendment for the inclusion of new species. The generic delimitations being to a large degree a matter of personal opinion, I prefer this treatment to the lumping of many different forms for 'phylogenetic' reasons.

The juvenile forms of *Hypoaspis* s. str. are described here for the first time (*H. rhinocerotis* and *H. athasiae*) and they agree to the general type of the free-living laelapids (vide *H. aculeifer* (Can.), Evans & Till, op. cit.). I should like to point out the 'long-haired' nature of the juveniles: the protonymph having longer setae than the deutonymph and this having longer setae than the adult.

The occurrence of macrosetae on the idiosoma as well as on the legs, mainly leg IV, seems to have arisen independently in various mesostigmatic mites associated

with arthropods. The function of the macrosetae is at present unknown, it may be mainly thigmotactic and concerned with finding the right location on the host, or it may also serve to avoid overcrowding on the host, assuring each mite its own volume of space.

## SUMMARY

The following species and genera of mites associated with phytophagous lamellicorn beetles are described and figured: *Hypoaspis neokrameri* sp. n. (♀); *Hypoaspis pentodoni* sp. n. (♀, ♂); *Hypoaspis phyllognathi* sp. n. (♀); *Hypoaspis integer* Berlese (♀); *Hypoaspis rhinocerotis* Ouds. (♀, ♂, dn, pn); *Hypoaspis athiasae* sp. n. (♀, ♂, dn, pn); *Hypoaspis dubius* sp. n. (♀); *Hypoaspis remilleti* sp. n. (♀); *Lucanaspis brachypedes* gen. n., sp. n. (♀); *Dynastaspis walhallae* gen. n., sp. n. (♀); *Angosomaspis multisetosus* gen. n., sp. n. (♀); *Promacrolaelaps hunteri* gen. n., sp. n. (♀).

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